

***Alaska: Glaciers of Kenai Fjords National Park and Katmai and Lake Clark  
National Parks and Preserve***

BRUCE A. GIFFEN<sup>1</sup>, DOROTHY K. HALL<sup>2</sup>, AND JANET Y.L. CHIEN<sup>3</sup>  
Kenai Fjords National Park and Katmai National Park and Preserve

1 Alaska Regional Office, National Park Service, 240 West 5th Ave., Anchorage, Alaska  
99501,

USA, [bruce\\_giffen@nps.gov](mailto:bruce_giffen@nps.gov).

2 Cryospheric Sciences Branch, Code 614.1, NASA/Goddard Space Flight Center,  
Greenbelt, MD 20771

USA, [dorothy.k.hall@nasa.gov](mailto:dorothy.k.hall@nasa.gov).

3 Consultant, Cryospheric Sciences Branch, Code 614.1, NASA/Goddard Space Flight  
Center, Greenbelt, MD 20771, USA

**Popular Summary**

Most of the Earth's small, land-terminating glaciers have been receding over the last 150 years, and the recession has accelerated in the last few decades. Many areas containing small glaciers have not yet been mapped in detail. In this paper, we document the comprehensive and detailed mapping of glaciers in Kenai Fjords National Park, Katmai National Park and Preserve and Lake Clark National Park and Preserve. Landsat Multispectral Scanner (MSS), Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) imagery was used to map glacier extent on a park-wide basis. Results of the analysis show that there has been a reduction in the amount of glacier ice cover all of the parks over the study period. For example, our measurements show a reduction of approximately 21 km<sup>2</sup>, or -1.5% (from 1986 to 2000), and 76 km<sup>2</sup>, or -7.7% (from 1986/87 to 2000), in Kenai Fjords and Katmai, respectively. This work represents the first comprehensive study of glaciers of Katmai and Lake Clark. The data have been provided as "shape files" to the Global Land Ice Monitoring from Space database so that future changes of glaciers in these parks can be documented.

**ABSTRACT**

There are hundreds of glaciers in Kenai Fjords National Park (KEFJ) and Katmai National Park and Preserve (KATM) covering over 2276 km<sup>2</sup> of park land (circa 2000). There are two primary glacierized areas in KEFJ – the Harding Icefield and the Grewingk-Yalik Glacier Complex, and three primary glacierized areas in KATM - the Mt. Douglas area, the Kukak Volcano to Mt. Katmai area and the Mt. Martin area. Most glaciers in these parks terminate on land, though a few terminate in lakes. Only KEFJ has tidewater glaciers, which terminate in the ocean. Glacier mapping and analysis of the change in glacier extent has been accomplished on a decadal scale using satellite imagery, primarily Landsat data from the 1970s, 1980s, and from 2000. Landsat

Multispectral Scanner (MSS), Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) imagery was used to map glacier extent on a park-wide basis. Classification of glacier ice using image processing software, along with extensive manual editing, was employed to create Geographic Information System (GIS) outlines of the glacier extent for each park. Many glaciers that originate in KEFJ but terminate outside the park boundaries were also mapped. Results of the analysis show that there has been a reduction in the amount of glacier ice cover in the two parks over the study period. Our measurements show a reduction of approximately 21 km<sup>2</sup>, or -1.5% (from 1986 to 2000), and 76 km<sup>2</sup>, or -7.7% (from 1986/87 to 2000), in KEFJ and KATM, respectively. This work represents the first comprehensive study of glaciers of KATM. Issues that complicate the mapping of glacier extent include: debris-cover (moraine and volcanic ash), shadows, clouds, fresh snow, lingering snow from the previous season, and differences in spatial resolution between the MSS and TM or ETM+ sensors. Similar glacier mapping efforts in western Canada estimate mapping errors of 3-4%. Measurements were also collected from a suite of glaciers in KEFJ and KATM detailing terminus positions and rates of recession using datasets including the 15-minute USGS quadrangle maps (1950/1951), Landsat imagery (1986/1987, 2000, 2006) and 2005 Ikonos imagery (KEFJ only).